

1. An apparatus for administering a suspendible agent in suspension, comprising:

a delivery container including a fluid reservoir capable of holding a propellant fluid, an exit port, a fluid path between said fluid reservoir and said

5 exit port, and a delivery mechanism operative for causing said propellant fluid to flow through said fluid path; and

a suspension apparatus disposed in said fluid path, said suspension apparatus including a radial flow channel and a plurality of circumferential flow channels coupled in fluid communication by said radial flow

10 channel, said radial flow channel and said plurality of circumferential flow

channels capable of being filled with the contrast agent and in fluid

communication with said exit port, wherein the contrast agent is delivered to said exit port after flowing through said radial flow channel and said plurality of circumferential flow channels when said delivery mechanism is operated to

15 cause propellant fluid to flow through said fluid path.

2. The apparatus of claim 1 wherein said suspension apparatus

further includes a plurality of circumferential dividing walls defining said plurality of circumferential flow channels.

3. The apparatus of claim 2 wherein said suspension apparatus

further includes a gap formed in a corresponding one of said plurality of circumferential dividing walls that defines said radial flow channel.

4. The apparatus of claim 2 wherein said suspension apparatus includes a first plate carrying said plurality of circumferential dividing walls.

5. The apparatus of claim 4 wherein said first plate includes a radial dividing wall intersecting said plurality of circumferential dividing walls for blocking the plurality of circumferential flow channels and diverting fluid flow through said radial flow channel.

6. The apparatus of claim 4 wherein said first plate includes opposed upstream and downstream surfaces, said plurality of dividing walls being distributed between said upstream and downstream surfaces.

7. The apparatus of claim 6 wherein said first plate includes an axial flow channel coupling circumferential flow channels on said downstream surface with circumferential flow channels on said upstream surface.

8. The apparatus of claim 4 wherein said first plate includes opposed upstream and downstream surfaces and an axial flow channel extending between said upstream and downstream surfaces.

9. The apparatus of claim 8 wherein said axial flow channel is located adjacent to a center of said first plate.

10. The apparatus of claim 8 wherein said axial flow channel is located adjacent to a peripheral edge of said first plate.

11. The apparatus of claim 4 wherein said suspension apparatus further comprises a second plate contacting said plurality of first dividing walls located on said upstream surface and a third plate contacting said plurality of first dividing walls located on said upstream surface so that said plurality of first dividing walls define said plurality of circumferential flow channels.

12. The apparatus of claim 11 wherein said second and said third plates each includes an axial flow channel coupling said plurality of circumferential flow channels and said plurality of radial flow channels with circumferential and radial flow channels of an adjacent first plate.

13. The apparatus of claim 4 wherein said suspension apparatus includes a second plate having an axial flow channel communicating with said plurality of circumferential flow channels, said second plate contacting said plurality of first dividing walls for defining said plurality of circumferential flow channels.

14. The apparatus of claim 2 wherein said plurality of first dividing walls include irregularities that cause contrast agent flowing in said plurality of circumferential flow channels to change direction.

15. The apparatus of claim 2 wherein said plurality of circumferential dividing walls have a concentric arrangement.

16. The apparatus of claim 1 wherein said suspension apparatus includes a pair of first plates, said plurality of circumferential flow channels and said plurality of radial flow channels being distributed between said pair of first plates.

17. The apparatus of claim 16 wherein said suspension apparatus includes a second plate positioned between said pair of first plates so as to separate said plurality of circumferential flow channels and said plurality of radial flow channels on an upstream surface of one of said pair of first plates  
5 from said plurality of circumferential flow channels and said plurality of radial flow channels on a downstream surface of the other of said pair of first plates.

18. The apparatus of claim 17 wherein said second plate includes an axial flow channel coupling said plurality of circumferential flow channels and said plurality of radial flow channels on one of said first plates with said plurality of circumferential flow channels and said plurality of radial flow channels on the  
5 other of said first plates.

19. The apparatus of claim 1 wherein said suspension device is positioned inside said delivery container.

20. The apparatus of claim 1 wherein said circumferential flow channels have a concentric arrangement.

21. An apparatus for administering a suspendible contrast agent in suspension, comprising:

    a delivery container including a fluid reservoir capable of holding a propellant fluid, an exit port, a fluid path between said fluid reservoir and said exit port, and a delivery mechanism operative for causing said propellant fluid to flow through said fluid path; and

    a suspension apparatus disposed in said fluid path, said suspension apparatus including a plurality of first and second plates with a stacked arrangement, each pair of said first and second plates being separated by a plurality of dividing walls defining a plurality of circumferential flow channels capable of being filled with the contrast agent, each of said plurality of first and second plates configured to permit axial flow between said plurality of circumferential flow channels of adjacent pairs of first and second plates, wherein the contrast agent is delivered to said exit port after flowing through said plurality of circumferential flow channels when said delivery mechanism is operated to cause propellant fluid to flow through said fluid path.

22. The apparatus of claim 21 wherein a ratio of a volume of said flow channels to a volume occupied by said dividing walls ranges from about 0.25 to about 0.5.

23. The apparatus of claim 21 wherein said set of flow channels includes a concentric plurality of circumferential flow channels and a plurality of radial flow channels, adjacent pairs of said circumferential flow channels being coupled in fluid communication by a corresponding one of said radial flow channels.

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24. The apparatus of claim 21 wherein each of said plurality of baffle plates and each of said plurality of spacer plates includes an axial flow channel to permit axial flow between adjacent sets of flow channels.

25. The apparatus of claim 21 wherein said suspension device is positioned inside said delivery container.

26. A method for administering a suspendable agent in suspension to a patient, comprising:

providing contrast agent in a fluid path including concentric circumferential flow channels coupled by radial flow channels and axial flow channels that confine the suspendable agent to maintain the suspension;

5 introducing a propellant fluid into the fluid path effective to cause the contrast agent to flow axially in the fluid path toward an exit port coupled with a patient; and

directing the suspendable agent circumferentially through the

10 concentric circumferential flow channels and radially through the radial flow channels thereby administering the suspendable agent in suspension to the patient.

27. The method of claim 26 wherein said suspendable agent is a microbubble-containing contrast agent.

28. The method of claim 26 further comprising:

directing the contrast agent through an axial flow channel coupling adjacent sets of circumferential flow channels and radial flow channels.

29. The method of claim 26 wherein directing the contrast agent further comprises:

directing the contrast agent circumferentially through a first set of the concentric circumferential flow channels and radially outward through a first 5 set of the radial flow channels; and

directing the contrast agent circumferentially through a second set of the concentric circumferential flow channels and radially inward through a second set of the radial flow channels

30. The method of claim 29 further comprising:

transferring the contrast agent from the first set of the concentric circumferential flow channels and the first set of the radial flow channels to the second set of the concentric circumferential flow channels and the second set 5 of the radial flow channels.

31. The method of claim 29 further comprising:

transferring the contrast agent from the second set of the concentric circumferential flow channels and the second set of the radial flow channels to the first set of the concentric circumferential flow channels and the 5 first set of the radial flow channels.

32. A method of filling a device for administering a suspendible agent in suspension to a patient, comprising:

aspirating a propellant fluid from a first bulk container through a fluid path including concentric circumferential flow channels coupled by radial flow channels and axial flow channels into a fluid reservoir of a delivery container; and

aspirating the suspendible agent from a second bulk container into the concentric circumferential flow channels, radial flow channels and axial flow channels of the fluid path.

33. The method of claim 32 wherein said suspendible agent is a microbubble-containing contrast agent.

34. The method of claim 32 wherein aspirating the volume of the suspendible agent further comprises:

displacing the propellant fluid resident in the concentric circumferential flow channels coupled by radial flow channels and axial flow channels into the fluid reservoir.